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(54) Brake actuator.

(57) A brake actuator has a body (8) containing a pair of brake-applying members (10, 11) which may be actuated hydraulically to separate the friction elements of a brake into engagement with a rotatable braking surface. The members (10, 11) are interconnected by a mechanism in the form of a shaft (12) of which respective end portions (13, 14) are provided with reversible threaded portions of opposite hand which engage corresponding threads (10A, 11A) within the members (10, 11), the shaft being constrained against axial movement between bearings (16, 17). Any excess movement of one of the members relative to the other is transmitted to that other member such as to cause an opposite proportional, usually equal, movement of said other member, irrespective of forces arising from servo effects in the brake.

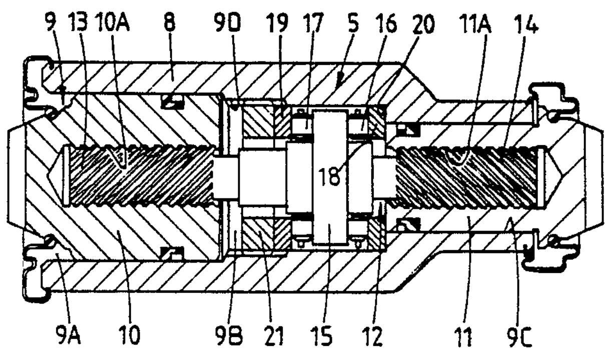

FIG.2.

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BRAKE ACTUATOR.

This invention relates to a brake actuator intended for use primarily, although not exclusively, with an internal shoe drum brake of the leading/trailing type, usually known as a simplex brake.

One characteristic of drum brakes is that they operate with a degree of self-energisation or servo derived from the rotating brake drum and this tends to increase the braking force on the leading shoe and reduce the braking force on the trailing shoe, as is well understood. A result of this is that the friction material of the leading shoe wears away at a faster rate than that of the trailing shoe with consequent inconvenience to users in terms of servicing requirements.

A proposal to deal with the unequal wear problem is illustrated in British Patent No.456238. This provides the trailing shoe with an automatic adjuster device coupled by a flexible drive element to the leading shoe so that adjustment is applied in equal amounts to both shoes. Although this partially corrects the unequal wear, the aforesaid characteristic of unequal braking forces at the respective shoes, which gives rise to the unequal wear, remains unchanged.

Another partial solution to the problem has been attempted by using friction linings of different thickness on the leading and trailing shoes, but this again deals with the effect of the problem rather than its fundamental cause and results in the inconvenience of "handed" shoes.

In a further prior proposal, a hydraulic actuator is provided with opposed pistons having different working areas, the pistons being arranged so that the larger actuating force is applied to the trailing shoe. Whilst this can in theory balance the forces applied respectively to the leading and trailing shoes, it is not entirely satisfactory because the geometry of the brake varies during use and it is difficult in practice to match the forces to the theoretical ideal.

An object of the present invention is to provide an improved brake actuator which enables actuating forces to be applied to the braking elements of a brake in a more balanced manner than hitherto.

According to the present invention, a brake actuator comprises a body carrying a pair of brake-applying members operable, in use, to separate friction elements into braking engagement with a rotatable braking surface, said members being interconnected by mechanism which acts to transmit any excess movement of one member relative to the other to that other member such as to cause an opposite proportional movement of said other member irrespective of the forces applied to the members, in use, by said friction elements.

In one convenient arrangement, the brake-applying members are threadedly engaged with respective oppositely handed threaded portions of a shaft mounted for rotation but axially constrained relative to said body, whereby said excess movement of one member causes rotation of the shaft and consequent proportional opposite, and preferably equal, movement of the other member.

Typically, axial constraint of the shaft is afforded by opposed faces of a flange of the shaft reacting, preferably by way of anti-friction bearings, against adjacent opposed faces fixed relative to the housing.

The invention will now be described, by way of example, with reference to the accompanying drawings in which:-

Figure I is an end elevation of an internal shoe drum brake incorporating an actuator in accordance with the invention, and

Figure 2 is a longitudinal cross-section of the actuator of the brake of Figure I.

The brake illustrated in Figure I has a back plate I upon which are mounted a pair of brake shoes 2 and 3, of which one pair of adjacent shoe ends engages a fixed abutment 4 secured to the back plate. An actuator 5 is fixed to the back plate between the other pair of adjacent shoe ends and is operable to expand the shoes 2 and 3 into braking engagement with a rotatable brake drum (not shown) against the action of shoe return springs 6 and 7. Because only one pair of shoe ends is actuated, the brake acts in a leading/trailing configuration and, for a direction of drum rotation indicated by the arrow R, the shoe designated L will act as the leading shoe and that designated T acts as the trailing shoe. A conventional brake of this type is subject to the disadvantages enumerated above and these are alleviated by the actuator of the invention which will now be described in more detail with reference to Figure 2 of the drawings.

The actuator 5 comprises a body 8 having a through bore 9 which is stepped at two locations to form a larger diameter bore portion 9A, an intermediate bore portion 9B and a smaller diameter bore portion 9C. The bore portions 9A and 9C contain respective tappets in the form of hydraulic pistons I0 and II, of which the piston I0 has a larger cross-sectional area subjected to hydraulic fluid pressure than the piston 9, the piston I0 engaging and actuating the shoe 2 and the piston II engaging and actuating the shoe 3 (Figure I). The pistons are hollow and provided with internal reversible threads I0A, IIA respectively of opposite hand and the pistons are interconnected by a shaft, indicated generally at I2, the shaft being provided with oppositely extending threaded portions I3, I4 corresponding to and engaged with the respective threads in the pistons. The shaft I2 is provided with a central radially extending flange I5, the oppositely facing surfaces of which are engaged respectively with roller bearings I6, I7 which also bear against respective relatively fixed hardened inserts I8, I9. The insert I8 abuts a shoulder 20 formed by the step in the cylinder which forms the smaller diameter bore portion 9C and the intermediate bore portion 9B has an internally threaded portion 9D which receives an externally threaded nut member 2I surrounding the shaft and acting to urge the assembly of the shaft I2, bearings I6, I7 and hardened inserts I8, I9 firmly into engagement with the shoulder 20 in order to constrain the shaft I2 against axial movement relative to the body 5 whilst at the same time permitting rotation of the shaft by way of the bearings I6, I7.

In order to actuate the brake, hydraulic fluid under pressure is supplied to the intermediate bore portion 9B and urges the pistons I0 and II in opposite directions outwardly of the body to expand the brake shoes 2 and 3. Because of the interconnection between the pistons provided by the oppositely handed reversible threads of the pistons and shaft I2, axial movement of the two pistons will tend to rotate the shaft.

However, since the brake has a leading/trailing configuration, the wear rate of the leading shoe actuated by the piston II may be greater than that of the shoe 2 and an excess of movement of the piston II relative to the piston I0 will then be necessary in order to apply the worn leading shoe against the drum. This excess movement will be translated by rotation of the shaft I2 into an equal movement in the opposite direction of the piston I0, so that both pistons move through the same actuating distance. Any additional force arising on the leading shoe as a result of the servo effect of the drum on that shoe is transmitted, by rotation of the shaft I2, to the trailing shoe, supplementing the actuating force on that shoe. The wear rates of the leading and trailing shoes are thereby substantially equalised so that the necessity for the various compensatory practices which have hitherto been necessary is largely obviated.

Although in the embodiment described the pistons I0 and II are of unequal diameters, it will be understood that equal diameter pistons may be employed and means alternative to the shoulder 20 will then be necessary to restrain the shaft I2 against axial movement. Such means, could, for example, be an additional nut equivalent to the nut 2I disposed at the opposite side of the flange I5 and engaging a corresponding thread in the housing. It would be possible to provide the external surface of the flange I5 with a worm or other suitable formation for engagement with a pinion for example to enable the shaft to be rotated manually. This arrangement could be particularly important when, in accordance with another alternative embodiment, at least one of the pistons is provided with automatic adjustment means to compensate for shoe wear in conventional manner. The rollers I6 and I7 may be replaced by other low friction devices such as washers provided with a low friction coating, for example.

For the majority of applications of the invention, the compensatory effect of the connecting mechanism on the tappet which moves least will be equal to the excess movement of the other tappet. The nature of the mechanism could, however, be varied to produce a greater or less compensatory effect, as required. In the case of the mechanism described having oppositely-handed threads, the pitch of the respective threads of the two threaded connections at the pistons may be different.

In a further alternative arrangement applicable to a drum brake, a sliding wheel cylinder may be employed, with the cylinder body slidingly mounted on the backplate and engaging one shoe, and a piston slidably mounted in the body and engaging the other shoe. The force-transmitting mechanism, conveniently in the form of a shaft similar to shaft I2 of the illustrated embodiment, may then interconnect the slidable body and piston, whilst being axially constrained by fixed structure, to provide the compensatory effect described above.

It would be possible to incorporate the actuator of the invention in a disc brake in which unequal pad wear problems occur for various reasons. Thus, in the particular example of a reaction-type disc brake in which one pad is directly actuated and the other indirectly actuated by reaction of the directly actuated pad against the disc, in known manner, the force transmitting mechanism, which may be similar to the drive shaft I2, could be disposed between the fixed caliper body containing the actuator piston and the sliding caliper which applies the indirectly actuated pad so that by the action of the oppositely handed threads described above, one of the pads may be screwed outwardly in accordance with the actuating movement of the other pad. The actuator of the invention may also be employed in a frame type disc brake caliper having a fixed body containing opposed actuating pistons, the drive shaft I2 then acting between the opposed pistons.

Claims

I. A brake actuator comprising a body (8) carrying a pair of brake-applying members (I0, II) operable, in use, to separate friction elements (2, 3) into braking engagement with a rotatable braking surface, characterised by mechanism (I2) interconnecting said members (I0, II) and acting to transmit any excess movement of one member (I0, II) relative to the other (I0, II) to that other member such as to cause an opposite proportional movement of said other member irrespective of the forces applied to the members (I0, II), in use, by said friction elements (I2, I3).

2. An actuator according to Claim I characterised in that the brake-applying members (I0, II) are threadedly engaged with respective oppositely handed threaded portions (I3, I4) of a shaft (I2) mounted for rotation but axially constrained relative to the body, whereby excess movement of one member (I0, II) causes rotation of the shaft and consequent proportional opposite movement of the other member.

3. An actuator according to Claim I or Claim 2 characterised in that said movements of the brake-applying members (I0, II) are equal.

4. An actuator according to Claim 2 or Claim 3 characterised in that axial constraint of the shaft (I2) is afforded by opposed faces of a flange (I5) of the shaft reacting against adjacent opposed faces fixed relative to the housing (8).

5. An actuator according to Claim 4 characterised in that anti-friction bearings (I6, I7) are disposed between said flange (I5) faces and the fixed faces against which they react.

6. An actuator according to any one of the preceding claims characterised in that said brake-applying members (I0, II) are hydraulic pistons.

7. An actuator according to Claim 6 characterised in that said pistons (I0, II) have different cross-sectional areas subjected to hydraulic actuating pressure.

8. An actuator according to Claim 6 characterised in that said pistons (I0, II) have equal cross-sectional areas subjected to hydraulic actuating pressure.

9. An actuator according to Claim 2 characterised in that the body (8) has respective end portions of different internal diameters housing said brake-applying members (I0, II), and an intermediate portion having a greater diameter than the smaller diameter one of said end portions, said shaft having a flange (I5) disposed within said intermediate body portion and reacting, at one side thereof, against a shoulder (20) formed at the junction between said smaller diameter and intermediate body portions and at its other side against an abutment member (2I) screwed into an internally threaded end part (9D) of the intermediate body portion remote from said smaller diameter portion.

I0. An actuator according to Claim 9 characterised in that anti-friction bearings (I6, I7) are disposed between the respective sides of the flange (I5) and inserts (I8, I9) located respectively against said shoulder (20) and abutment member (2I).

II. An actuator according to any one of Claims 2 to I0 characterised in that the pitches of the screw threads (I3, I4) are the same.

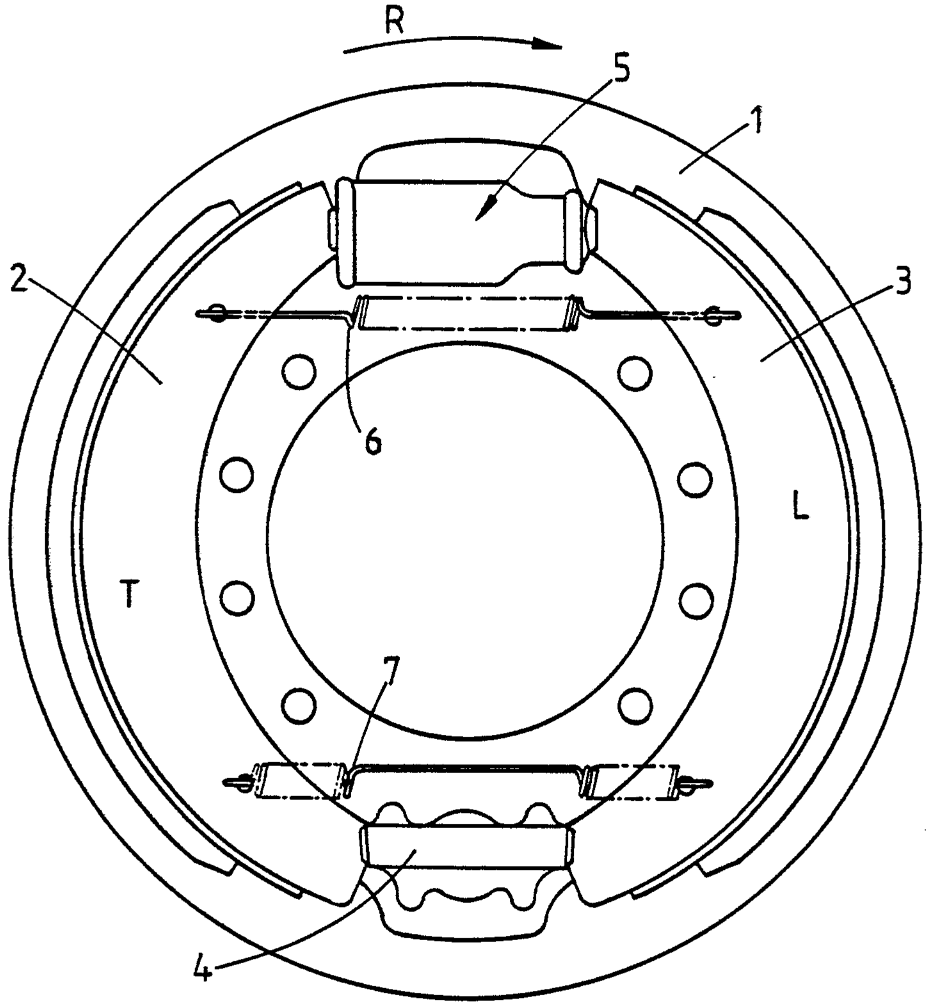
R
5
1
2
3
6
L
T
7
4

FIG.1.

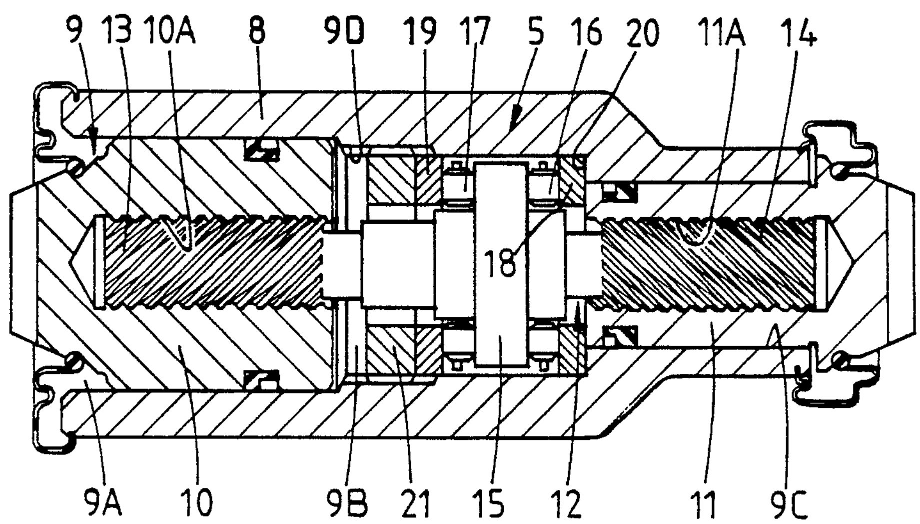
9
13
10A
8
9D
19
17
5
16
20
11A
14
18
9A
10
9B
21
15
12
11
9C

FIG.2.